

## PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY  
(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

|   |  |  |
|---|--|--|
| Applicant's or agent's file reference<br>70965-74214                                      | FOR FURTHER ACTION    See Form PCT/IPEA/416              |  |
| International application No.<br>PCT/SE2004/000603  | International filing date (day/month/year)<br>20-04-2004 | Priority date (day/month/year)<br>25-04-2003 |
| International Patent Classification (IPC) or national classification and IPC<br>H01P 5/18 |  |  |
| Applicant<br>Telefonaktiebolaget LM Ericsson (publ) et al                                 |  |  |

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
  - a. ☒ (sent to the applicant and to the International Bureau) a total of 2 sheets, as follows:
    - ☐ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
    - ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
  - b. ☐ (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) \_\_\_\_\_, containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

- |                                     |              |   |
|-------------------------------------|--------------|---|
| <input checked="" type="checkbox"/> | Box No. I    | Basis of the report   |
| <input type="checkbox"/>            | Box No. II   | Priority  |
| <input type="checkbox"/>            | Box No. III  | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability  |
| <input type="checkbox"/>            | Box No. IV   | Lack of unity of invention  |
| <input checked="" type="checkbox"/> | Box No. V    | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input checked="" type="checkbox"/> | Box No. VI   | Certain documents cited   |
| <input type="checkbox"/>            | Box No. VII  | Certain defects in the international application  |
| <input type="checkbox"/>            | Box No. VIII | Certain observations on the international application   |

|   |   |
|---|---|
| Date of submission of the demand<br><br>23-02-2005  | Date of completion of this report<br><br>27-06-2005                         |
| Name and mailing address of the IPEA/SE<br>Patent- och registreringsverket<br>Box 5055<br>S-102 42 STOCKHOLM<br>Facsimile No. +46 8 667 72 88 | Authorized officer<br><br>Bo Gustavsson/MN<br>Telephone No. +46 8 782 25 00 |

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.

PCT/SE2004/000603

## Box No. I Basis of the report

1. With regard to the language, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

- ☐ This report is based on a translation from the original language into the following language \_\_\_\_\_, which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the elements of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

- ☐ the international application as originally filed/furnished
- ☒ the description:
- pages 1-18 \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the claims:
- pages \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ as amended (together with any statement) under Article 19
- pages\* 19-20 \_\_\_\_\_ received by this Authority on 23.02.2005
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☒ the drawings:
- pages 1/12-12/12 \_\_\_\_\_ as originally filed/furnished
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- pages\* \_\_\_\_\_ received by this Authority on \_\_\_\_\_
- ☐ a sequence listing and/or any related table(s) – see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

- ☐ the description, pages \_\_\_\_\_
- ☐ the claims, Nos. \_\_\_\_\_
- ☐ the drawings, sheets/figs \_\_\_\_\_
- ☐ the sequence listing (*specify*): \_\_\_\_\_
- ☐ any table(s) related to the sequence listing (*specify*): \_\_\_\_\_

\* If item 4 applies, some or all of those sheets may be marked "superseded."

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

## 1. Statement

|                               |        |                  |     |
|-------------------------------|--------|------------------|-----|
| Novelty (N)                   | Claims | <u>1-11</u>      | YES |
|                               | Claims |                  | NO  |
| Inventive step (IS)           | Claims | <u>6, 7</u>      | YES |
|                               | Claims | <u>1-5, 8-11</u> | NO  |
| Industrial applicability (IA) | Claims | <u>1-11</u>      | YES |
|                               | Claims |                  | NO  |

## 2. Citations and explanations (Rule 70.7)

## Documents cited in the International Search Report:

- D1: IEEE Transactions on Microwave Theory and Techniques, Vol. 47, No. 9, Sept. 1999, pages 1873-1882  
D2: 13<sup>th</sup> Int. Conf. on Microwaves, Radar and Wireless Commun., MIKON 2000, Vol. 3, pages 131-155  
D3: IEEE MTT-S Int. Microwave Symposium Digest, Vol. 2, June 1996, pages 1181-1184  
D4: IEEE Transactions on Microwave Theory and Techniques, Vol. 51, No. 6, June 2003, pages 1743-1751  
D5: US 5767753 A1

The document D1 is regarded as being the closest prior art to the subject-matter of claims 1 and 8, and discloses multilayer two- and three-strip directional couplers for monolithic and hybrid MIC's. The document also discloses a method of designing the directional couplers by adapting certain relations between and/or dimensions of the strip conductors, the ground plane and the respective dielectric films, so as to obtain a desired coupling between the strip conductors. With reference to chapter III, page 1878 and figures 1(h) and 6(a), it seems clear that the distance between the first and the second strip conductors, the distance between the first conductor and the ground plane and the also the width of the first and second conductors may be adapted so as to contribute to a desired coupling (k) under compensation conditions ( $kL=kC=k$ ).

Document D2 (see chapter III, figures 3.1 and 3.2) and document D3 (see page 1182), also show methods for achieving a desired coupling for multilayer directional coupler by adapting the dimensions of the conductors and the distances between conductors and at least one ground plane.

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## Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX V

Document D4 is published after the priority date of the present application.

Document D5 describes the general prior-art in directional couplers.

The invention as claimed in the amended claims 1 and 8 differs from the closest prior-art described in D1 by defining the electrical length of the directional coupler to be a quarter or less of length of the propagated wave.

The problem to be solved by the present invention may therefore be regarded as obtaining an optimal coupling effect in an improved directional coupler.

However, it is a well-known option for a person skilled in the art to design a directional coupler having a coupling length of a quarter of a wavelength of the operating frequency. The skilled person having knowledge of the device described in D1 would therefore not hesitate to design the directional coupler accordingly.

The invention as claimed in the amended claims 1 and 8 cannot therefore be considered to involve an inventive step.

The technical features of the invention as claimed in claims 2-5 and 9-11 are also as such known from the document D1, with reference to the embodiments showing multilayer asymmetric directional couplers.

Therefore, the invention as claimed in claims 2-5 and 9-11 is not considered to involve an inventive step.

The invention as claimed in claims 6-7 has been found to be new and to involve an inventive step, as none of the cited documents describe or suggest a directional coupler having the proposed design.

The invention is also considered to fulfil the requirements for industrial applicability.

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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**Box No. VI** Certain documents cited

## 1. Certain published documents (Rule 70.10)

Application No.  
Patent No.  
\_\_\_\_\_Publication date  
(day/month/year)  
\_\_\_\_\_Filing date  
(day/month/year)  
\_\_\_\_\_Priority date (valid claim)  
(day/month/year)  
\_\_\_\_\_

See Supplemental Box

## 2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure  
\_\_\_\_\_Date of non-written disclosure  
(day/month/year)  
\_\_\_\_\_Date of written disclosure  
referring to non-written disclosure  
(day/month/year)  
\_\_\_\_\_

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of: BOX VI

IEEE Transactions on Microwave Theory and Techniques, Vol. 51,  
No. 6, June 2003, pages 1743-1751

JCO9 Rec'd PCT/PTO 24 OCT 2005

CLAIMS (amended)

1. A directional coupler comprising coupled lines (8, 9), including a first line (8) and a second line (9), and at least one ground plane (10, 11, 13), characterised in that at least one of the ground planes is a tuning ground plane (10, 11, 13), in that a distance (14, 25), between the first (8) and the second (9) line, and each distance (15, 17, 26, 27), between the first line (8) and the respective tuning ground plane (10, 11, 13), are adapted so as to contribute to a desired coupling level under compensation conditions, and in that an electrical length of the directional coupler is a quarter or less of length of the propagated wave.

2. A directional coupler according to claim 1, wherein the width of the first and/or the second line (8, 9) are adapted so as to contribute to a desired coupling level under compensation conditions.

3. A directional coupler according to any of the preceding claims, wherein the distance (14, 25) between the first (8) and the second (9) line refers to a horizontal distance (14, 25) in a direction parallel to the at least one ground plane (10, 11, 13) and perpendicular to a longitudinal direction of the coupled lines (8, 9).

4. A directional coupler according to any of the preceding claims, wherein the second line (9) and the at least one tuning ground plane (10, 11, 13) are located on the same side of the first line (8).

5. A directional coupler according to any of the preceding claims, comprising at least two conductive layers (4, 5, 6, 7), whereby at least one dielectric layer (1, 2, 3) is interposed between the conductive layers.

6. A directional coupler according to any of the preceding claims, wherein the first line (8) comprises at least two strips separated in a vertical direction and electrically joined by means of at least one connection (21).

7. A directional coupler according to any of the preceding claims, characterised in that a region between the first and the second lines (8, 9) comprises at least partly a gas, and at least one dielectric layer (1, 2, 3) is arranged between the second line (9) and the at least one tuning ground plane (10, 11, 13), whereby each distance (26, 27) between the first line (8) and the respective tuning ground plane (10, 11, 13) is dependent on the respective distance (15, 24) between each tuning ground plane (10, 11, 13) and a boundary between the gas and the dielectric layer (1, 2, 3).

8. A method for achieving coupling in a directional coupler under compensated conditions, the coupler comprising coupled lines (8, 9), including a first (8) and a second (9) line, and at least one ground plane (10, 11, 13), characterised in that it comprises choosing a distance (14, 25), between the first (8) and the second (9) line, and each distance (26, 27), between the first line (8) and an edge of at least one of the ground planes (10, 11, 13), so as to contribute to a desired coupling level under compensation conditions, in addition to which an electrical length of the directional coupler is a quarter or less of the wavelength.

9. A method according to claim 8, wherein the width of the first and/or the second line (8, 9) are chosen so as to contribute to a desired coupling level under compensation conditions.

10. A method according to claim 8 or 9, wherein the distance (14, 25) between the first (8) and the second (9) line refers to a horizontal distance (14, 25) in a direction parallel to the at least one ground plane (10, 11, 13) and perpendicular to a longitudinal direction of the coupled lines (8, 9).

11. A method according to claim 8, 9 or 10, wherein the second line (9) and said respective edge of at least one of the ground planes (10, 11, 13) are positioned on the same side of the first line (8).